



Roscommon County Council
Comhairle Chontae Roscomáin

Roscommon Landfill Environmental Monitoring

Annual Environmental Report 2006

March 2009

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1. INTRODUCTION

Roscommon Landfill is operated by Roscommon County Council in accordance with Waste Licence Register No. W0073-01 issued by the EPA. In accordance with Condition 5.2 of the Licence, acceptance of waste for disposal at the landfill ceased on December 31st 2001. The reporting period for the purposes of this Annual Environmental Report (AER) is January 1st 2008 to December 31st 2008.

This Annual Environmental Report (AER) has been prepared in accordance with the conditions of the Waste Licence and the EPA "Draft Guidance on Environmental Management Systems and Reporting to the Agency, 1999".

2. SITE DESCRIPTION

Roscommon Landfill is located in the townland of Killarney, approximately 3km north east of Roscommon town on the N63 Longford Road. The total area of waste covers an area of approximately 5 hectares. Landfilling commenced at this location in the early 1970's. The landfill has always operated on a "dilute and disperse" principle. Initially filling of the landfill took place in the area between the road and the present culvert. In 1981, filling commenced to the south and the west of this culverted stream. A halting site was built at the facility in 1980. Landfilling at the facility ceased on December 31st 2001. When the landfill was active the principal activity was the deposit of domestic, commercial and industrial non-hazardous waste.

It is estimated that up to 170,000 tonnes of waste were deposited at the site over its lifetime. A Recycling Centre is in operation at the site which accepts recyclables such as paper, glass and cardboard (see Table 3.1). Domestic waste is also accepted for disposal which is transferred to Ballaghaderreen Landfill.

3. QUANTITY AND COMPOSITION OF WASTE

Table 3.1 and **Figure 3.1** outline the quantities of waste accepted for recovery during the reporting period at the Recycling Centre. A total of 876.56 tonnes of material was recovered in 2008. The total amount of material accepted for recycling in 2007 at the Recycling Centre

amounted to 927.87 tonnes. Therefore in 2008 there was a 5.5% decrease in the amount of waste recycled at the Recycling Centre in comparison with 2007. Up until the end of April, the waste was collected for recycling by Bergins Waste Disposal, (WO 163-1), Rehab, KMK Metals Recycling Ltd. (WO 113-02), Returnbatt (WO 105-01), Enva (WO 145-02), Indaver (WO 36-02), Textiles Recycling Ltd and Airpack. From May 2008, Repak continue to collect glass and KMK Metals collect WEEE waste. Barna Waste collect all other waste.

Table 3.2 and **Figure 3.2** provide figures for the total tonnage of waste accepted for disposal in previous years. These figures regarding waste intake at the facility are highly approximate as there was no weighbridge on site until shortly before closure in 2001. Data on the composition of the waste for these years is unavailable.

Table 3.1 Quantity and Composition of Waste Received for Recovery at the Recycling Centre in 2008

Waste Type	EWC Code	Waste Collector	Waste Quantities (Tonnes)
Cardboard, Newspaper, Glossy Magazines, Milk Cartons	200101 / 200199	Bergins / Barna Waste	394.02
PET 1, PET 2, Metal Cans, Aluminium Cans	150102 / 150104	Bergins / Barna Waste	146
Waste Electrical & Electronic Equipment	200135*; 200307	KMK Metals Recycling Ltd.	137.36
Batteries	200133*; 200134	Returnbatt/Barna Waste	9.48
Household hazardous	200127*	Indaver/ Barna Waste	6.42
Aeroboard	150102	Airpack/ Barna Waste	2.3
Textiles	200111	Textile Recycling Ltd./ Barna Waste	24.52
Clear Glass	200102	REHAB/ Barna Waste	125.48
Metals	200139	Barna Waste	11.82
Wood	200138	Barna Waste	19.16
Total Tonnage			876.56

* Hazardous

Figure 3.1 Waste Intake for 2008

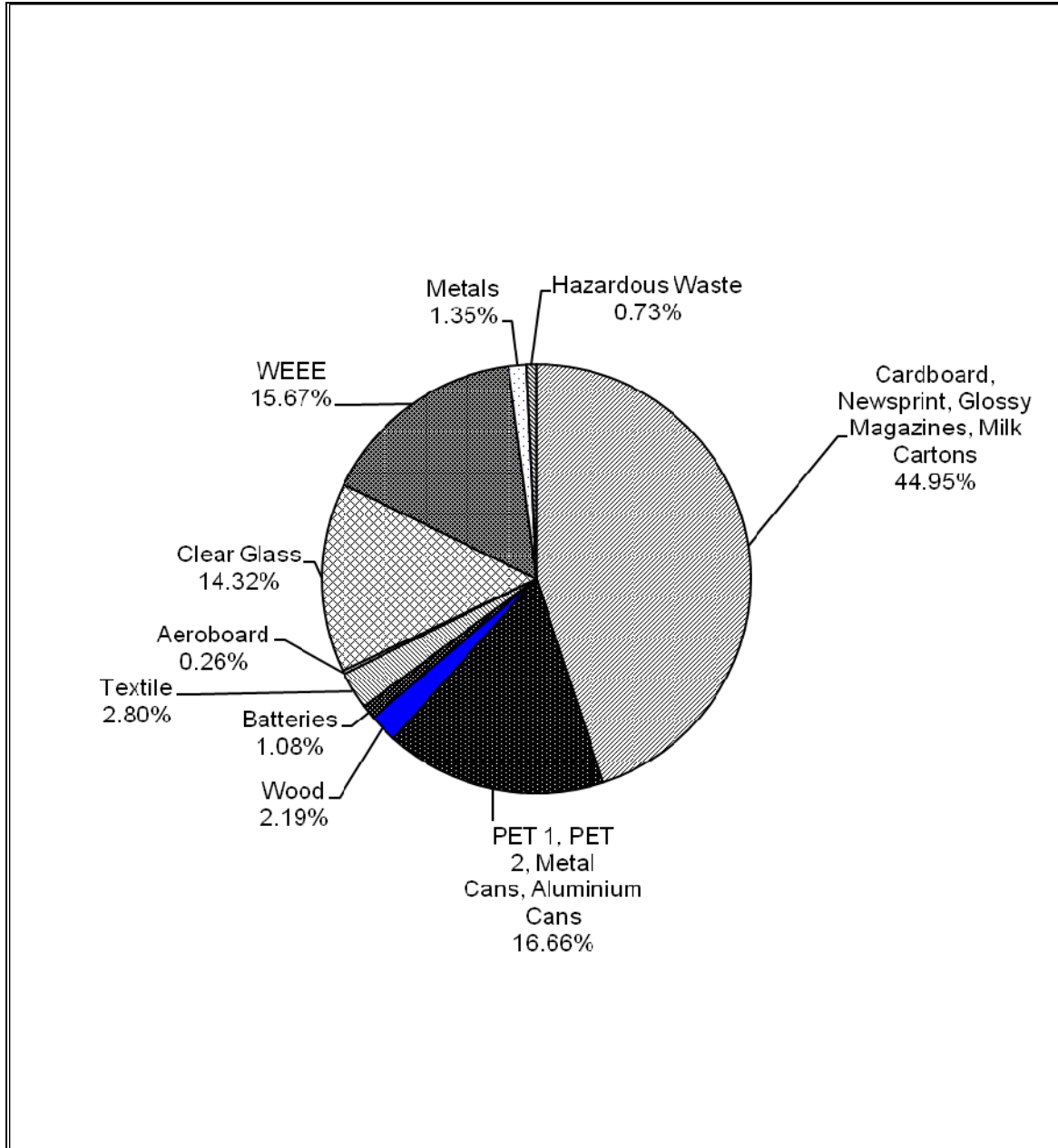
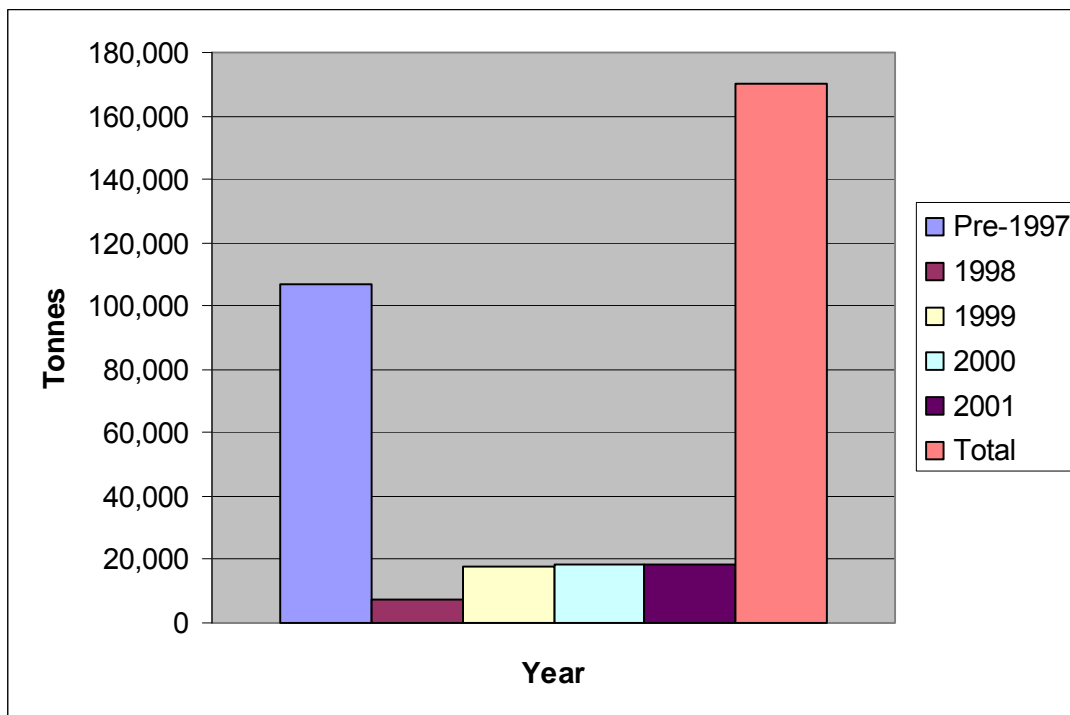


Table 3.2 Total Estimated Waste Intake at Roscommon Landfill up to Close of Facility in 2001

Year	Approximate Waste intake (tonnes)
To end 1997	107,000 (estimate)
1998	7,535
1999	18,000
2000	18,360
2001	18,727
Total	170,000 (approx)

Figure 3.2 Waste Intake for Years Up to Close of Facility in 2001

4. ENVIRONMENTAL MONITORING

During the reporting period of 2004, it was agreed with the EPA that, as the landfill was closed and fully capped, the scale and scope of the Environmental Monitoring Programme could be reduced to reflect the level of current operations at the facility. A site plan showing the revised monitoring locations is included in **Appendix A**.

The following sections summarise the environmental monitoring undertaken at Roscommon Landfill during the reporting period (2008). The Waste Licence for Roscommon Landfill requires that biannual monitoring be carried out in respect of surface water, ground water, leachate and gas. A letter dated the 8th January 2008 was sent to the EPA North Western Regional Office of Environmental Enforcement on behalf of Roscommon County Council. The letter requested a review of the licence. Roscommon County Council suggested that the extent and frequency of monitoring could be decreased in 2008. In this regard it was proposed that quarterly reporting should be reduced to biannual reporting. The EPA agreed the review of the licence in this respect.

4.1 SURFACE WATER

For each half of 2008, samples of surface water were taken by Roscommon County Council from 3 no. monitoring locations, namely SW1, SW3, & SW7 (see DG0001F08 in Appendix A). All results are tabulated within **Appendix B**. Those parameters which are required to be analysed on an annual basis were monitored during the 2nd half of 2008. The results were compared with the European Community (Quality of Surface Water intended for Abstraction of Drinking Water) Regulations, 1989 (S.I. No. 294 of 1989), the EPA's Environmental Quality Objectives and Environmental Quality Standards (a discussion document, from 1997) and the Fresh Water Fish Directive 78/659/EEC. The following interpretation summarises the overall surface water quality. More detailed interpretations can be found within the biannual monitoring reports which were submitted to the EPA.

4.1.1 Interpretation and Non-compliance

Throughout the sampling period (Jan-Dec 2008) the main exceedances of standards were caused by elevated concentrations of ammonia, chemical oxygen demand (COD), suspended

solids and manganese and lowered levels of dissolved oxygen at sampling points SW1, SW3 and SW7.

Ammonia concentrations fluctuated through the year with a maximum concentration of 1.13 mg/l at SW7 during the first half OF 2008 (H1 '08). Concentrations were elevated above the 1989 Regulations limit of 0.2 mg/l at SW7 on both sampling occasions. SW3 was compliant with the limit value in H1 '08 but exceeded the limit value in H2. SW1 sampling results were below the limit of 0.2mg/l on both sampling occasions.

The **COD** levels were above the limit of 40 mg/l set for water classified as A3 at sampling point SW3 in H1 '08. SW1 and SW7 were compliant with the limit value on this occasion. The COD levels exceeded the limit value at all three monitoring points in H2. The maximum concentration was recorded at SW3 during the 2nd half with a level of 90 mg/l.

Dissolved oxygen concentrations at the three sampling points were compliant with the standard of 100% for all samples to be > 7 mg/l in the 1st half of '08. Sampling points SW3 and SW7 did not meet the standard in H2 with lowest levels recorded at 4.49mg/l and 6.68mg/l respectively.

The level of **Suspended Solids** was below required limits at sampling points SW1 and SW7 on both sampling occasions but the concentration of 125 mg/l in SW3 in H1 exceeded the required limit of 25 mg/l set by the FW Fish Directive 78/659/EEC. The level of suspended solids in SW3 also exceeded the limit in Q4 '07 at 35 mg/l, but was below the required limit in Q3 '7 at 21 mg/l. The concentrations recorded at SW1 and SW7 have been consistently compliant in the Q2, Q3 and Q4 sampling of 2007 and H1 '08. Levels of suspended solids at all three monitoring points were compliant in H2 '08.

All of the sampling points were below the limit for **BOD, pH, Chloride, Temperature and Electrical Conductivity**. **BOD** levels were below the standard limit of 5mg/l at all sampling points on both sampling occasions. This represents a great improvement on last year's results; the BOD level recorded in SW1 exceeded the limit value in the third and final quarters of '07 and the BOD level in SW3 exceeded the limit value in the third quarter of '07. The figures for maximum, minimum and mean were all lower in the second half of '08 than the results for the first half.

A visual inspection of the water quality showed that there was no odour evident at any time. Plant growth was consistent for SW3 throughout the year, while heavy weed growth was noted in SW7 in H1 and SW1 in H2. No discolouration of water was noted at any monitoring point on either occasion. Weed growth and water discolouration at SW3 and SW7 has been noted on previous inspections.

Annual sampling of a range of other parameters was also carried out in the 2nd half of 2008. The concentrations of cadmium, chromium, copper, lead, magnesium, mercury, phenols, potassium, sodium, sulphate, total phosphorus and zinc were under the 1989 Regulations limits. The majority of results were slightly higher than those recorded for Q4, 2007. However, levels of Potassium have increased from a mean of 1 µg/l in Q4 2007 to 2.53 µg/l for this monitoring period. The only exceeding parameter was manganese which was above the relevant standards at SW3 and SW7.

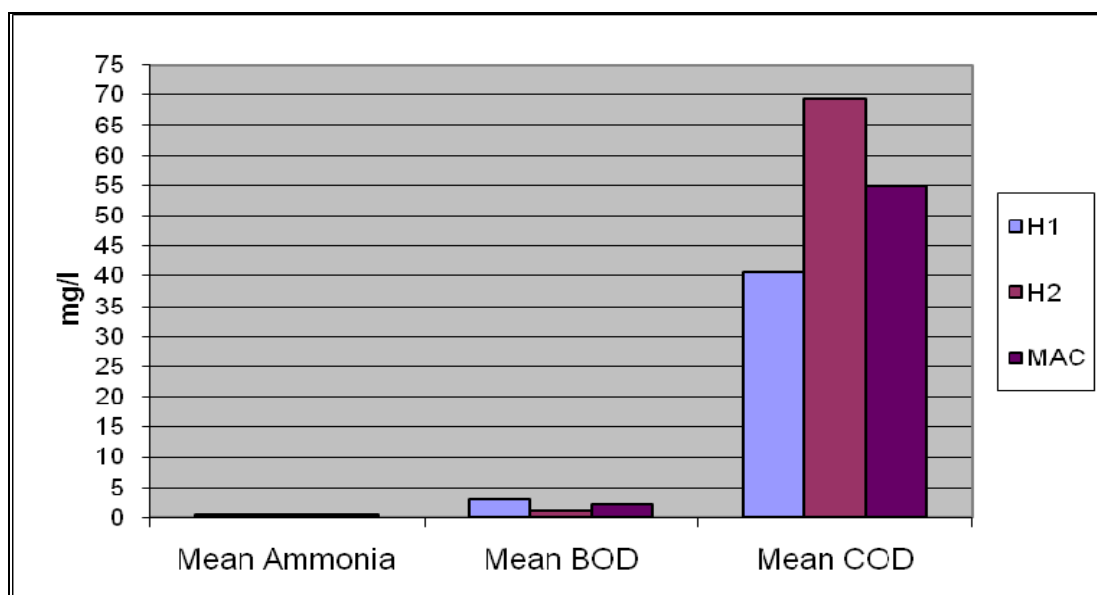
The standard limit for manganese is 50 µg/l. Levels recorded for this parameter were 85 µg/l and 54.9 µg/l at SW3 and SW7 respectively. SW 3 and SW7 also exceeded the limit in last year's monitoring. The concentration of manganese recorded at SW3 has increased by 11 µg/l while the level recorded at SW7 has decreased by 30 µg/l. The mean manganese level has decreased from 67 mg/l in Q4 '07 to 54.67 mg/l for this monitoring period.

A summary of the mean concentrations of the key parameters for surface water for the reporting period can be seen in **Figure 4.1**.

4.1.2 Proposals

As the landfill is now capped and the leachate interceptor drain and abstraction system is preventing lateral migration of leachate into the stream, it is likely that contamination in the watercourses is as a result of accumulated contaminants in the banks of the streams. This contamination should decrease over time.

Figure 4.1 Mean Concentrations of Key Parameters for Surface Water for the Reporting Period



4.2 GROUNDWATER

Groundwater monitoring points are situated both upgradient and downgradient of the landfill. The locations of these points are shown on drawing **DG0001-01F08** in **Appendix A**. The groundwater sampling points GW2, GW4 and GW6 were analysed for the suite of parameters agreed with the Agency. The following interpretations summarise the overall water quality, the results of which are contained within **Appendix B**. Those parameters which require to be analysed on an annual basis were monitored during the second half of 2008. Detailed interpretations can be found within the quarterly monitoring reports which were submitted to the EPA.

4.2.1 Interpretation and Non-Compliance

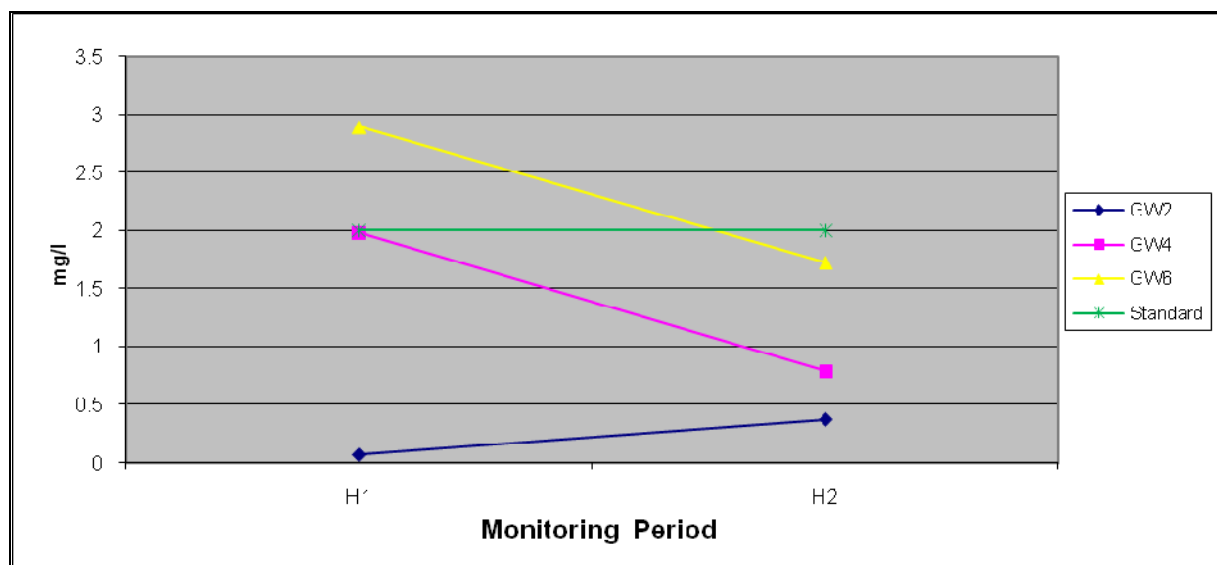
Ammonia concentrations exceeded the guideline value at all three monitoring points in the second half of 2008. GW4 and GW6 have also been non compliant during Q2, Q3 and Q4 of 2007 and in H1 of 2008. Sampling point GW2 has been compliant with the guideline value during Q3 and Q4 in 2007 and in H1 of 2008, and so the H2 result marks a deterioration in water quality at this monitoring point. The results over the course of the year ranged from 0.07 – 2.89 mg/l. The highest value of 2.89 mg/l was recorded at GW6 in the first half of 2008 and is

lower than the highest level of ammonia recorded at this sampling point in 2007 (4.18 mg/l). A summary of these results can be seen in **Figure 4.2**.

The interim guideline for **Dissolved Oxygen** indicates that there are no abnormal changes over the monitoring period. The minimum, maximum and mean concentrations for DO for H2, 2008 were 2.1, 4.33 and 2.1 mg/l, while the minimum, maximum and mean concentrations for DO for the first half of 2008 were 7.17, 8.12 and 7.56 mg/l. A significant change occurred in dissolved oxygen concentration at all three sampling points during the reporting period.

Values for **Electrical Conductivity, Temperature and pH** were within the guideline limits at all sampling points on all sampling occasions.

Figure 4.2 Ammonia Levels in Groundwater for the Reporting Period



Additional parameters were tested in the second half of 2008. The concentrations of cadmium, chromium, copper, lead, magnesium, mercury, phenols, potassium, sodium, sulphate, total phosphorus and zinc were all below the standard guideline values set. Most results are lower than those recorded for Q4, 2007.

The iron level at GW6 exceeded the standard of 200µg/l in this monitoring period, with a concentration of 308 µg/l, while levels of manganese were elevated at all three sampling points. Iron and manganese occur naturally from the weathering of iron and manganese bearing minerals and rocks. In addition, many complex reactions which occur naturally in ground formations can give rise to many soluble forms of iron, which will therefore be present in waters passing through such formations. However, such elevated iron and manganese levels may also be attributed to pollution from organic wastes. There were no other exceedances.

Groundwater levels are tabulated in **Appendix B**. Levels were recorded at the end H1 (26th June 2008) and at the end of H2 (17th December 2008). Levels decreased at all locations from H1 to H2, the highest variation being 0.5 mbgl at GW4.

4.2.2 Proposals

Leachate abstraction is ongoing from the leachate interceptor drain and from leachate boreholes in the waste body reducing infiltration of leachate to groundwater. As the landfill is capped, there is a minimum amount of leachate being generated. The combined effect of these measures should demonstrate a continual improvement in the quality of the groundwater over time.

4.3 LEACHATE

Samples of leachate were taken by Roscommon County Council from the 3 no. chambers situated on the leachate interceptor drain and at the leachate lagoon (see **DG0001F08** in **Appendix A**). The results of this analysis are contained within **Appendix B**. The following interpretation summarises the overall leachate quality. More detailed interpretations can be found within the biannual monitoring reports which were submitted to the EPA.

4.3.1 Interpretation and Non-compliance

Levels in each leachate chamber dropped by a similar magnitude between Q4 '07 and H1 '08. LMH1, LMH2 and LMH 3 dropped in level by 0.45, 0.36 and 0.41 metres respectively. Levels rose in each chamber between H1 and H2 '08 by 0.65, 0.7 and 0.6 metres in LMH1, LMH2 and LMH3 respectively. The operation of a leachate pumping system installed by Roscommon

County Council during the summer of 2004 is set to automatically maintain leachate levels in the landfill and in the interceptor drain.

Most of the parameters measured were at the lower end of the expected range of values for leachate (**Table 4.1**). However, levels of chromium, manganese, iron, copper, zinc and cadmium were higher than would be expected of an older landfill (the level for cadmium is from LMH3 only; levels were below limits of detection at the other sampling points). There was an overall decrease in the strength of the leachate over the reporting period (**Figure 4.3**).

Figure 4.4 shows the change in BOD/COD ratio over the reporting period. A maximum value of 0.31 was recorded in the second half of 2008. The BOD/COD ratio is typically assumed to drop from 0.8 to 0.1 over a 30 year period. A BOD/COD ratio of less than 0.25 is typical of the methanogenic phase leachate. The maximum value of 0.31 for BOD/COD is slightly higher than this but is still not high enough to be put in the acetogenic phase (which typically has a BOD/COD ratio of >0.4). Other contaminants analysed are within the scale in terms of leachate strength as defined in the EPA Landfill Site Design Manual.

Table 4.1 Comparison of Typical Leachate Composition Values and Values at Roscommon Landfill

Determinant	Unit	High values (young landfill)	Low values (old landfill)	Values at Roscommon Landfill for H2 2008
pH	-	6-8	7-8	7.06
Conductivity	µS/cm	5,000-20,000	2,500-10,000	548.06
COD	mg/l	8,000-12,000	4,000-6,000	38.33
BOD ₅	mg/l	7,000-10,000	2,000-3,000	11.81
Tot – P	mg/l	10-25	1-5	0.18
Chloride	mg/l	1,000-5,000	100-1,000	31.66
Magnesium	mg/l	50-1,500	10-50	13.33
Potassium	mg/l	500-1,500	50-200	16.7
Chromium	mg/l	<1	<0.1	2.37
Manganese	mg/l	<5	<0.5	901.67
Iron	mg/l	10-150	1-5	5804.6
Copper	mg/l	<1	<1	6.33
Zinc	mg/l	10	1-5	9.13
Cadmium	mg/l	<0.1	<0.01	0.1*
Mercury	mg/l	<0.01	<0.001	BLD
Lead	mg/l	1-2	<1	0.3*

BLD – Below Limits of Detection

*These values are from LMH3 only. Levels were below limits of detection at LMH1 and LMH2.

Figure 4.3 Mean Concentrations of Key Leachate Parameters Over the Reporting Period

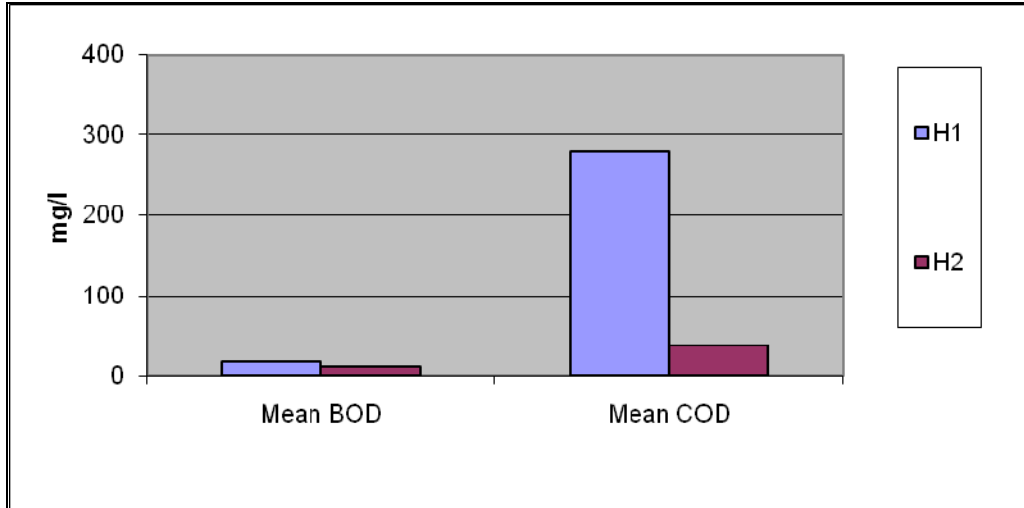
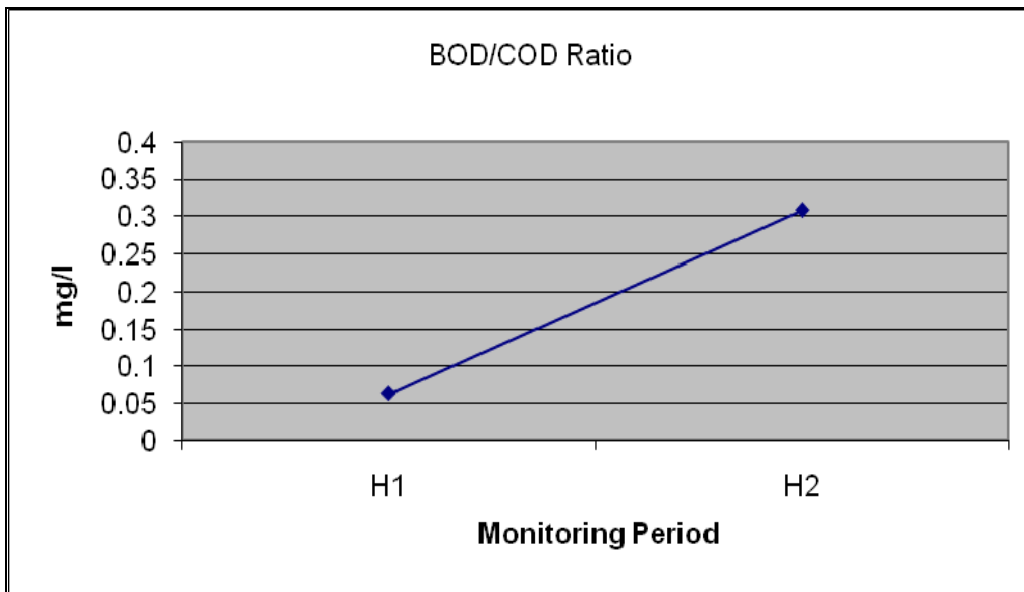


Figure 4.4 BOD/COD Ratio in Leachate over the Reporting Period



4.3.2 Proposals

Monitoring of leachate will continue in 3 no. leachate chambers on the interceptor drain as agreed with the EPA.

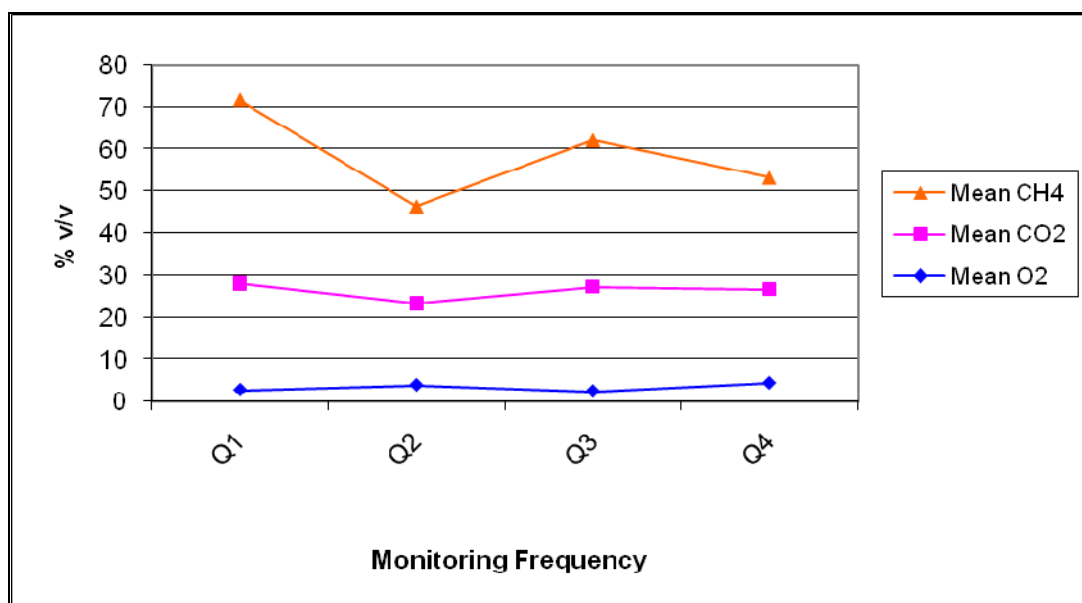
4.4 DUST

As the facility is a closed and capped landfill and since no construction work is ongoing at the site, it was agreed with the EPA in 2004 that dust monitoring could cease at the facility.

4.5 LANDFILL GAS

Roscommon County Council undertakes landfill gas monitoring on a quarterly basis at 10 no. gas extraction boreholes as shown on DG0001F08 (**Appendix A**). Analysis was performed on each sample for methane (CH_4), carbon dioxide (CO_2), oxygen (O_2), temperature and pressure, the results of which are contained in **Appendix B**. The quality of landfill gas varies somewhat throughout the year with methane concentrations varying between 46% and 72% v/v and carbon dioxide concentrations between 23% v/v and 29% v/v (reaching a maximum of 28.2 in H1). Mean oxygen levels remain fairly constant throughout the monitoring period. **Figure 4.5** provides a summary of the mean concentrations of the main components of the landfill gas over the monitoring period.

Figure 4.5 Summary of Mean Concentrations of Main Components of Landfill Gas

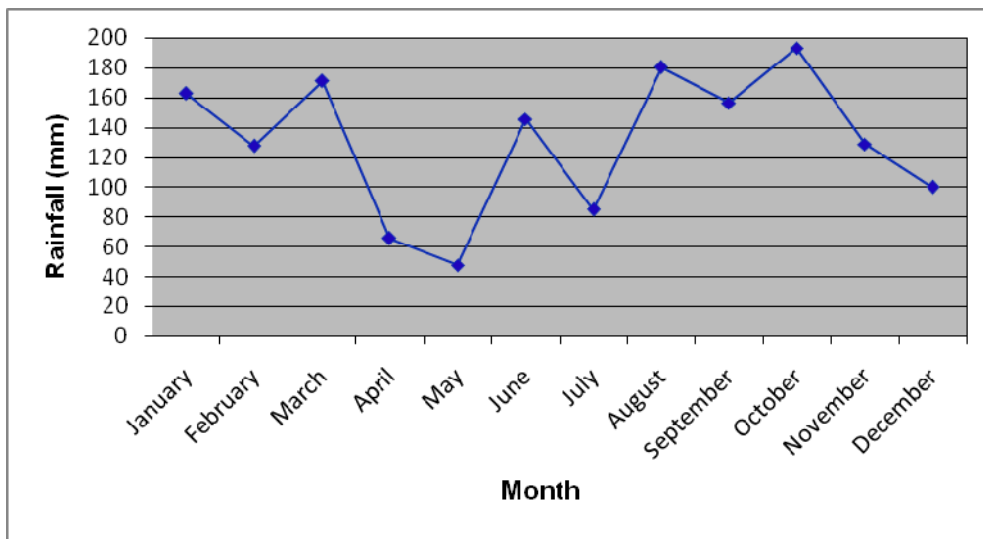


4.6 METEOROLOGICAL DATA

The daily meteorological data for 2008 from Knock Airport weather station can be seen in Appendix C. This includes rainfall, wind speed, min and max temperature, relative humidity and pressure data.

Figure 4.6 illustrates monthly rainfall data for 2008. A total of 1564 mm of rain fell at Knock Airport in 2008.

Figure 4.6 Monthly Rainfall Data for 2008 from Knock Airport Weather Station



5. MASS BALANCE OF SPECIFIED SUBSTANCES

5.1 RESOURCE AND ENERGY CONSUMPTION SUMMARY

708.1 units of electricity were used during the reporting period.

5.2 EMISSIONS TO GROUNDWATER

The landfill operated on a “dilute and disperse” basis with no leachate containment measures put in place whereby the leachate generated was allowed to drain into surface and groundwater, becoming diluted and attenuated. The layers of peat and marl below the waste appear to have been effectively acting as a natural liner. The quality of the groundwater should improve as the landfill is capped and leachate abstraction continues in the leachate interceptor drain being provided around the landfill perimeter.

5.3 MONTHLY WATER BALANCE CALCULATION AND INTERPRETATION

Monthly rainfall data obtained from the nearest Met Eireann weather station at Knock, Co. Mayo estimated that the site received approximately 1564 mm of rainfall for the year 2008.

Prior to capping, it is estimated that, on average, approximately 22,700 m³ of leachate was generated on an annual basis at Roscommon Landfill. Records for 2008 indicate that 2,072 m³ of leachate were tankered to Roscommon WWTP in the period.

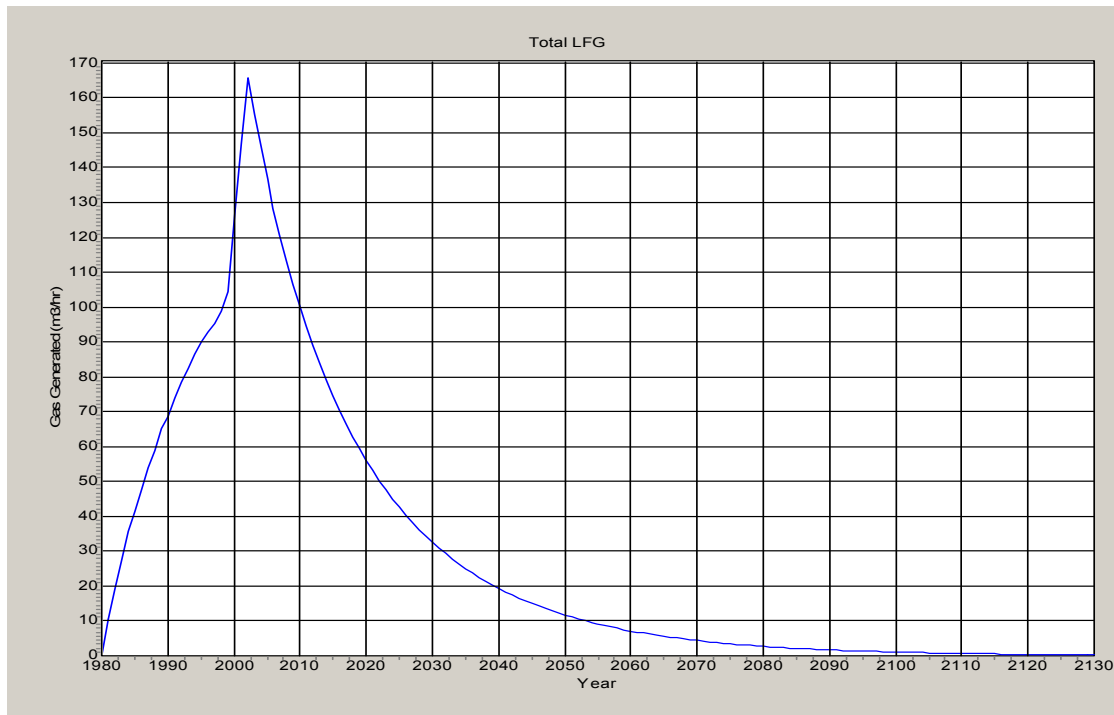
5.4 LANDFILL GAS VOLUMES

Under optimum conditions one tonne of degradable waste can theoretically produce 400-500m³ of landfill gas (including moisture content). In practical terms the rate at which landfill gas which may be collected for utilisation purposes may be much lower.

It is estimated that the waste disposed of in Roscommon Landfill contains on average 50% biodegradable waste. It is therefore assumed that the gas production is approximately 200 Nm³ of gas per tonne of waste over a 30 year period.

Gas volumes have been estimated using GASSIM, a gas modelling programme developed by the UK Environment Agency. Total bulk landfill gas generated is estimated at 120m³/hr, equating to 1.05 million m³/yr. The estimated rate of gas generation at this landfill since 1980 is graphed in **Figure 5.1**.

A 100 m³/hr enclosed gas flare, 10 no. landfill gas extraction wells and connecting pipework were installed at the landfill in 2003. The gas management system was commissioned during the summer of 2004.

Figure 5.1 Estimated Total Gas Generation from Roscommon Landfill

6. SITE DEVELOPMENT WORKS

6.1 DEVELOPMENT WORKS DURING THE REPORTING PERIOD

As part of the new servicing contract with Barna Waste a new slab was constructed to facilitate compactor skips.

During 2008 external contractors serviced the flare. Details of the report pertaining to this have not yet been circulated. Irish Biotech Systems (IBS) were commissioned in mid 2008 to maintain the flare under a new contract. They also contributed to balancing the gas field to prolong the flare operation hours.

6.2 PROPOSED DEVELOPMENT WORKS

There are no proposals for works at the facility for 2009.

7. PROCEDURES

A revised Environmental Management Plan (EMP) for the facility was issued in December 2004.

8. STAFFING AT ROSCOMMON LANDFILL

Table 8.1 shows the site management structure at Roscommon Landfill.

Table 8.1 Site Management Structure at Roscommon Landfill

Position		Employee Contact details
Director of Services Mr Tommy Ryan		Environmental Section, Roscommon County Council, Courthouse, Roscommon. Telephone No: 090 6637100 Fax No: 090 6637108
Senior Executive Officer Mr. Pat Murtagh		Environmental Section, Roscommon County Council, Courthouse, Roscommon.
Senior Staff Officer Sarah Scott	Senior Executive Engineer Mr. John Mockler	Environmental Section, Roscommon County Council, Courthouse, Roscommon.
Facility Manager Mr. Noel Martin		Environmental Section, Roscommon County Council, Courthouse, Roscommon.
Deputy Facility Manager/Landfill Caretaker Mr. Joe Casey		Environmental Section, Roscommon County Council, Courthouse, Roscommon.
Site Operatives Mr. Martin Kiernan		Environmental Section, Roscommon County Council, Courthouse, Roscommon.

9. REVIEW OF NUISANCE CONTROLS

9.1 LITTER ABATEMENT

As waste is no longer being accepted at the site and all landfilled waste is covered, there is no litter problem at the facility. The Recycling Centre is continuously maintained and monitored by Council operatives and all recyclables are deposited into covered, lockable containers. Any loose litter around the facility and its environs is collected.

9.2 NOISE AND DUST

With the closure of the landfill, there is no heavy machinery and little heavy vehicular traffic to the site. Noise and dust do not pose any problems and monitoring ceased in 2004 with the agreement of the Agency.

9.3 VERMIN CONTROL

Capping of the landfill has included the installation of a geosynthetic clay liner tying into the leachate interceptor drain around the waste, thus forming a continuous barrier around the main waste body. This barrier is augmented by a clay cover which is 1m thick resulting in little or no access to the waste for nuisances such as vermin or birds. In addition, Roscommon County Council employs ECOLAB to operate a vermin control programme. During the summer months, AOK pest control are engaged in the control of flies for Roscommon County Council.

9.4 ODOUR

As waste is no longer being accepted at the site and any landfilled waste is covered, there is no odour problem at the facility. The gas flare treats landfill gas at the facility.

10. REPORTS ON FINANCIAL PROVISIONS

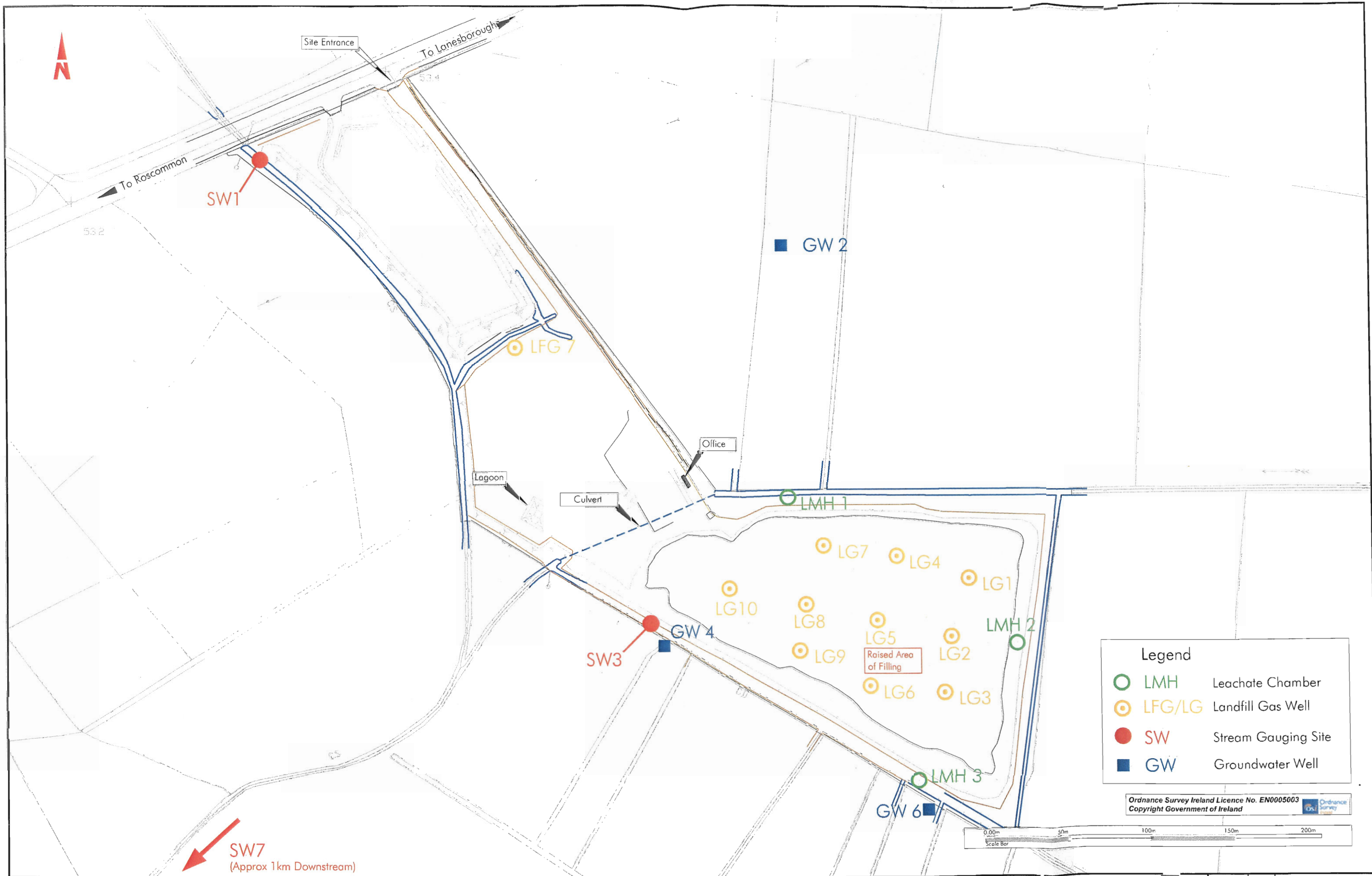
Roscommon County Council allocates funding on an annual basis from general resources. The funding will be maintained in an amount always sufficient to underwrite the current Restoration and Aftercare Plan in accordance with Condition 11 of the Waste Licence.

11. ENVIRONMENTAL INCIDENTS AND COMPLAINTS

No incidents or complaints were reported for the year 2008.

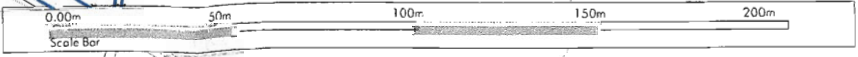
APPENDIX A

**SITE LAYOUT LOCATIONS OF MONITORING POINTS
(DG0001-01F08)**



Legend	
	LMH Leachate Chamber
	LFG/LG Landfill Gas Well
	SW Stream Gauging Site
	GW Groundwater Well

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CONNAUGHT
managing our waste better

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NOTES

1. This drawing is the property of RPS-Consulting Engineers. It is a confidential document and must not be copied, used, or its content divulged without prior written consent.
2. All Levels refer to Ordnance Survey Datum, Malin Head
3. DO NOT SCALE, use figured dimensions only if in doubt ask.

No.	Date	Amendment / Issue	App.
F08	06.09.07	Final Issue	W.M.

Roscommon County Council

Roscommon Landfill Environmental Monitoring

Site Layout Locations of Monitoring Points

Drawn by:	C.N.	Job No:	MGE0016
Checked by:	S.A.	File No:	MGE0016DG0001
Approved by:	A.F.	Orig. No:	Rev:
Scale:	1:2000@A3	DG0001-01	F08
Date:	May '03		

APPENDIX B

Monitoring Results

APPENDIX C

Meteorological Data

Surface Water Results

Roscommon County Council,

Roscommon Landfill

Date of Monitoring : 26th June 2008

Sampling point	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	DO mg/l	pH	Suspended Solids mg/l	Temperature °C
SW1	0.13	0.81	23.00	17.76	658.00	13.20	7.81	1.00	15.60
SW3	0.14	4.77	66.00	53.39	774.00	7.90	7.61	125.00	16.90
SW7	1.13	3.28	33.00	28.87	7.64	11.64	7.64	1.00	15.40
Standard	0.20 ¹	5.00 ¹	40.00 ¹	250.00 ¹	1000.00	100%>7 ²	5.5-8.5 ¹	25.00 ²	25.00 ¹
Mean	0.47	2.95	40.67	33.34	479.88	10.91	7.69	42.33	15.97
Min	0.126	0.810	23.000	17.760	7.640	7.900	7.610	1.000	15.400
Max	1.130	4.770	66.000	53.390	774.000	13.200	7.810	125.000	16.900

¹Surface Water Regulations 1989 A1 unless otherwise specified²Freshwater Fish Directive 78/659/EEC as ammended

Ground Water Results

Roscommon County Council,

Roscommon Landfill

Date of Monitoring : 26th June 2008

Sampling point	Ammonia mg/l N	Conductivity @ 20°C	Levels mbgl	DO mg/l	pH	Temperature °C
GW2	0.07	766.0	1.50	7.40	7.20	13.00
GW4	1.98	839.0	1.10	7.17	7.04	13.70
GW6	2.89	833.0	0.80	8.12	7.02	13.10
Standard	0.15 ¹	1000.00 ²	-	No ³ abnormal change	6.5-9.5 ³	25.00 ³
Mean	1.65	812.67	1.13	7.56	7.09	13.27
Min	0.07	766.00	0.80	7.17	7.02	13.00
Max	2.89	839.00	1.50	8.12	7.20	13.70
Mean	1.65	812.67	1.13	7.56	7.09	13.27

¹ GSI Trigger Values² EQSs for surface water³ Drinking water standards

Leachate Results**Roscommon County Council,****Roscommon Landfill**

Date of Monitoring : 26th June 2008

Sampling point	Ammonia mg/l N	BOD mg/l	COD mg/l	Chloride mg/l CL	Conductivity @ 20°C	Depth mbgl	pH	Temperature °C
LMH1	82.25	7.50	85.00	199.03	2510.00	3.15	7.30	15.20
LMH2	0.00	39.00	720.00	836.43	903.00	2.80	7.41	14.70
LMH3	17.56	7.10	34.00	48.52	6870.00	2.30	7.40	15.50
Mean	33.27	17.87	279.67	361.33	3427.67	2.75	7.37	15.13
Min	0.00	7.10	34.00	48.52	903.00	2.30	7.30	14.70
Max	82.25	39.00	720.00	836.43	6870.00	3.15	7.41	15.50
Mean	33.27	17.87	279.67	361.33	3427.67	2.75	7.37	15.13

Roscommon Landfill Gas Monitoring. January - June 2008

Quarterly Analysis : Date : 31st January 2008

Sampling point	Time	Temp	CH4	CO2	O2	Atm Pressure
		(°C)	(% v/v)	(% v/v)	(% v/v)	(m/bars)
LFG1	11:30	5.6	68.9	33.7	0.7	991
LFG 2	11:32	6.00	69.60	33.20	0.10	990.00
LFG 3	11:34	5.70	68.40	35.00	0.00	990.00
LFG 4	11:36	6.00	69.90	32.50	0.00	990.00
LFG 5	11:38	6.20	71.30	31.10	1.30	990.00
LFG 6	11:40	5.10	77.20	26.20	0.20	990.00
LFG 7	11:42	5.40	80.40	22.40	1.10	990.00
LFG 8	11:44	5.70	65.40	35.70	3.90	990.00
LFG 9	11:46	6.10	73.10	29.40	1.20	990.00
LFG 10	11:48	6.00	72.50	30.00	0.90	990.00
Site Office	12:00		0.00	1.00	21.10	
		Mean	71.67	28.2	2.77	

Date : 17th June 2008

Sampling Pt	Time	Temp	CH4	CO2	O2	Atm Pressure
		(°C)	(% v/v)	(% v/v)	(% v/v)	(m/bars)
LFG1	16:00	15.6	28.1	24.8	0.5	996
LFG 2	16:05	15.80	30.20	25.80	0.30	996
LFG 3	16:07	15.20	30.40	20.40	5.30	996
LFG 4	16:09	15.70	27.10	27.10	0.30	996
LFG 5	16:20	14.90	61.50	31.80	0.90	996
LFG 6	16:22	15.90	50.70	22.60	3.60	996
LFG 7	16:24	16.10	43.70	19.00	5.90	996
LFG 8	16:26	15.60	62.80	34.10	1.10	996
LFG 9	16:28	15.30	61.70	25.50	1.10	996
LFG 10	16:30	15.80	67.70	25.50	1.10	996
Site Office	16:45		0.00	1.00	23.50	996
		Mean	46.39	23.42	3.96	

Overall results	CH ₄	CO ₂	O ₂
	(%v/v)	(%v/v)	(%v/v)
Mean	59.03	25.81	3.37
Min	0.00	1.00	0.00
Max	80.40	35.70	23.50

Surface Water Visual Inspection/Odour Results

Roscommon County Council,

Roscommon Landfill

Licence No. 73-01

Date of Monitoring : 26th June 2008

Weather Conditions : Wet and Windy

Surface water Monitoring Point	Time	Results / Findings
SW1	13:00	Clear, No Odour
SW3	13:15	Lots of Weed Growth
SW7	14:35	Lots of Weed Growth

Surface Water Results

Roscommon County Council,

Roscommon Landfill

Date of Monitoring : 17th December 2008

Sampling point	Ammonia mg/l N	BOD mg/l	Cadmium µg/l	COD mg/l	Chloride mg/l CL	Chromium µg/l	Conductivity @ 20°C	Copper µg/l	DO mg/l	Iron µg/l	Lead µg/l	Magnesium mg/l	Manganese µg/l	Mercury µg/l	pH	Phenols µg/l	Potassium mg/l	Sodium mg/l	Sulphate mg/l SO ₄	Suspended Solids mg/l	Temperature °C	Total Phosphorus mg/l P	Zinc µg/l
SW2	0.09	0.74	BLD	44.00	17.30	1.00	653.00	7.00	7.97	38.20	BLD	7.10	24.10	BLD	7.73	BLD	2.40	10.00	8.97	2.00	6.70	0.03	8.30
SW3	0.67	1.59	BLD	90.00	19.76	BLD	591.00	7.00	4.49	141.00	BLD	7.50	85.00	BLD	7.51	BLD	2.40	10.90	20.74	7.00	5.80	0.03	7.50
SW7	0.41	0.65	BLD	74.00	16.48	BLD	613.00	6.00	6.68	124.00	BLD	7.60	54.90	BLD	7.66	0.01	2.80	9.20	18.15	1.00	6.20	0.05	8.60
Standard	0.20	5.00	5.00	40.00	250.00	50.00	1000.00	50.00	100% ^{2s} >7 ^{2s}	200.00	50.00	-	50.00	1.00	5.5-8.5 ¹	0.50	-	-	200.00	25.00	25.00	0.50	3000.00
Mean	0.39	0.99	0.00	69.33	17.85	17.85	619.00	6.67	6.38	101.07	0.00	7.40	54.67	0.00	7.63	0.00	2.53	10.03	15.95	3.33	6.23	0.04	8.13
Min	0.09	0.65	0.00	44.00	16.48	16.48	591.00	6.00	4.49	38.20	0.00	7.10	24.10	0.00	7.51	0.01	2.40	9.20	8.97	1.00	5.80	0.03	7.50
Max	0.67	1.59	0.00	90.00	19.76	19.76	653.00	7.00	7.97	141.00	0.00	7.60	85.00	0.00	7.73	0.01	2.80	10.90	20.74	7.00	6.70	0.05	8.60

¹Surface Water Regulations 1989 A1 unless otherwise specified²Freshwater Fish Directive 78/659/EEC as amended^{2s}Freshwater Fish Directive 78/659/EEC as amended (Salmonid)^{2c}Freshwater Fish Directive 78/659/EEC as amended (Cyprinid)

Surface Water Visual Inspection/Odour Results

Roscommon County Council,

Roscommon Landfill

Licence No. 73-01

Date of Monitoring : 17th December 2008

Weather Conditions : Dry and Cold

Surface water Monitoring Point	Time	Results / Findings
SW2	13:00	Weed Growth, No Odour
SW3	13:15	Weed Growth, No Odour
SW7	14:35	Clear, No Odour

Ground Water Results

Roscommon County Council,

Roscommon Landfill

Date of Monitoring : 17th December 2008

Sampling point	Ammonia mg/l N	Cadmium µg/l	Chloride mg/l CL	Chromium µg/l	Conductivity @ 20°C	Copper µg/l	Levels mbgl	DO mg/l	Iron µg/l	Lead µg/l	Magnesium mg/l	Manganese µg/l	Mercury µg/l	pH	Phenols µg/l	Potassium mg/l	Sodium mg/l	Sulphate mg/l SO ₄	Temperature °C	Total Phosphorus mg/l P	Zinc µg/l
GW2	0.37	BLD		BLD	793.00	8.00	1.00	2.10	52.70	BLD	16.20	93.50	BLD	7.12	BLD	2.20	12.60	31.24	9.30	0.01	8.40
GW4	0.79	0.10		3.20	823.00	7.00	0.55	4.33	106.00	BLD	16.40	104.00	BLD	7.21	BLD	2.40	16.60	23.11	9.10	NT	15.70
GW6	1.72	BLD		1.80	843.00	6.00	0.45	3.78	308.00	BLD	12.90	129.00	BLD	7.19	BLD	1.20	17.00	0.99	9.70	NT	14.90
Standard	0.15	5.00	30.00	30.00	1000.00	30.00	-	No abnormal change	200.00	10.00	50000.00	50.00	1.00	6.5-9.5	0.50	5.00	150.00	200.00	25.00	0.03	100.00
Mean	0.96	0.03	0.00	1.67	819.67	7.00	0.67	3.40	155.57	0.00	15.17	108.83	0.00	7.17	0.00	1.93	15.40	18.45	9.37	0.00	13.00
Min	0.37	0.10	0.00	1.80	793.00	6.00	0.45	2.10	52.70	0.00	12.90	93.50	0.00	7.12	0.00	1.20	12.60	0.99	9.10	0.01	8.40
Max	1.72	0.10	0.00	3.20	843.00	8.00	1.00	4.33	308.00	0.00	16.40	129.00	0.00	7.21	0.00	2.40	17.00	31.24	9.70	0.01	15.70
Mean	0.96	<0.2		2.50	819.67	0.36	0.67	3.40	155.57	<3.06	15.17	108.83	0.17	7.17	<0.05	1.93	15.40	18.45	9.37	0.024	13

Leachate Results**Roscommon County Council,****Roscommon Landfill**

Date of Monitoring : 27th November 2007

Sampling point	Ammonia mg/l N	BOD mg/l	Cadmium µg/l	COD mg/l	Chloride mg/l CL	Chromium µg/l	Conductivity @ 20°C	Copper µg/l	Depth mbgl	Iron µg/l	Lead µg/l	Magnesium mg/l	Manganese µg/l	Mercury µg/l	pH	Potassium mg/l	Sodium mg/l	Sulphate mg/l SO ₄	Temperature °C	Total Phosphorus mg/l P	Zinc µg/l
LMH1	34.16	16.00	BLD	62.00	51.50	4.30	1.20	7.00	2.50	6447.00	BLD	20.70	780.00	BLD	6.92	34.60	67.00	BLD	6.80	0.43	13.00
LMH2	1.92	18.00	BLD	43.00	14.84	1.20	755.00	6.00	2.10	10930.00	BLD	7.80	763.00	BLD	6.94	3.90	10.10	BLD	6.80	0.07	4.80
LMH3	7.09	1.43	0.10	10.00	28.64	1.60	888.00	6.00	1.70	36.80	0.30	11.50	1162.00	BLD	7.32	11.60	28.80	5.48	7.00	0.04	9.60

Mean	14.39	11.81	0.03	38.33	31.66	2.37	548.07	6.33	2.10	5804.60	0.10	13.33	901.67	0.00	7.06	16.70	35.30	1.83	6.87	0.14	6.85
Min	1.92	1.43	0.10	10.00	14.84	1.20	1.20	6.00	1.70	36.80	0.30	7.80	763.00	0.00	6.92	3.90	10.10	5.48	6.80	0.04	4.80
Max	34.16	18.00	0.10	62.00	51.50	4.30	888.00	7.00	2.50	10930.00	0.30	20.70	1162.00	0.00	7.32	34.60	67.00	5.48	7.00	0.43	13.00

Mean	14.39	11.81	<0.2	38.33	31.66	2.37	548.07	6.33	2.10	5804.60	0.30	13.33	901.67	0.17	7.06	16.70	35.30	5.48	6.87	0.18	9.13
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Roscommon Landfill Gas Monitoring. July-December 2008

Quarterly Analysis : Date : 29th September 2008

Sampling Pt	Time	Temp	CH ₄	CO ₂	O ₂	Atm Pressure (m/bars)
		(°C)	(% v/v)	(% v/v)	(% v/v)	
LFG 1	11:45	11.5	57.9	33.6	1	1013
LFG 2	11:47	11	63.5	35.1	0.6	1013
LFG 3	11:49	10.8	64.2	34.4	0.4	1013
LFG 4	11:58	11.2	52.5	30.2	0.6	1013
LFG 5	12:00	10.5	62.8	34.1	1.1	1013
LFG 6	12:02	10.2	63.6	34.2	0.8	1013
LFG 7	12:05	11.5	64.3	34.2	0.3	1013
LFG 8	12:08	10.6	64.1	35.7	0.2	1013
LFG 9	12:11	11.3	59.1	26.1	0.1	1013
LFG 10	12:03	10.5	68.8	3.05	0.4	1013
Site Office	12:00		0	1	21.5	
Mean			62.08	27.4227	2.45	

Quarterly Analysis : Date : 17th December 2008

Sampling Pt	Time	Temp	CH ₄	CO ₂	O ₂	Atm Pressure (m/bars)
		(°C)	(% v/v)	(% v/v)	(% v/v)	
LFG 1	12:30	7.6	47.5	28.9	2.6	1008
LFG 2	12:32	7.1	57.5	28.5	1	1008
LFG 3	12:35	8.2	42.9	26.4	3	1008
LFG 4	12:37	6.9	64.7	30.5	0.8	1008
LFG 5	12:39	7.5	18.2	10.7	12.5	1008
LFG 6	12:42	7.8	57.6	33.1	1.1	1008
LFG 7	12:45	6.2	63.8	35.8	0.9	1008
LFG 8	12:50	6.8	64.4	34.5	0.5	1008
LFG 9	13:00	7.9	52.9	30.6	0.7	1008
LFG 10	13:10	8	62.2	34.7	1.5	1008
Site Office	13:12		0	1	24.1	
Mean			53.17	26.7909	4.43	

Overall results	CH ₄	CO ₂	O ₂
	(%v/v)	(%v/v)	(%v/v)
Mean	57.63	27.02	3.44
Min	18.20	3.05	0.10
Max	68.80	35.80	12.50

APPENDIX C

Meteorological Data

USMH	PN	USCL (m)	USIL (m)	Diameter (mm)	Fall (m)	Slope (1:x)
F01	1	73.95	72.7	225	1.2	123.6
F02	1.001	73.35	71.5	225	0.377	176.1
F03	1.002	73.138	71.123	225	0.341	172.8
F04	1.003	72.457	70.782	225	0.277	160.4
C05	1.004	72.41	70.505	225	0.59	167.5
C05A	1.005	72.4	69.915	225	0.29	159.5
C05B	1.006	71.7	69.625	225	0.102	156.8
C05C	1.007	71	69.523	225	0.163	157.6
C05D	1.008	70	69.36	225	0.091	139.4
C06	1.009	70.054	69.269	225	0.129	288.9
C07	2	70.27	69.217	225	0.19	126.1
C08	2.001	70.17	69.027	225	0.037	114.7
C09	1.01	69.97	68.84	375	0.262	142.7
C10	1.011	70.28	68.578	375	0.013	207.7
C11	1.012	70.3	68.565	375	0.196	373.8
C12	1.013	70.7	68.369	375	0.44	183.8
C13	1.014	70.97	67.929	375	0.112	179.3
C14	1.015	70.3	67.817	375	0.402	189.8
C27Q	3	70.535	69.855	150	0.432	40.1
C27P	3.001	70.273	69.423	150	0.123	80.7
C27O	3.002	70.268	69.3	150	0.158	84.1
C27N	3.003	70.247	69.142	150	0.066	320.6
C27F	4	71.366	70.696	150	0.349	33.6
C27E	4.001	71.397	70.347	150	0.414	38.7
C27D	4.002	71.403	69.933	150	0.378	28.7
C27C	4.003	71.155	69.555	150	0.479	40.3
C27B	3.004	70.556	69.076	150	0.176	162.2
C27M	5	70.4	69.81	150	0.183	69.5
C27L	5.001	70.377	69.627	150	0.072	101.5
C27K	5.002	70.292	69.555	150	0.185	103
C27J	5.003	70.1	69.37	150	0.21	80.5
C27i	6	70.066	69.406	150	0.166	99.9
C27H	6.001	70.05	69.24	150	0.08	95.5
C27G	5.004	70.04	69.16	150	0.26	121.7
C27A	3.005	70.6	68.9	150	0.447	69.8
C18	3.006	70.58	68.303	300	0.133	392.2
C18A	3.007	71.18	68.17	300	0.024	383.9
C19	3.008	70.74	68.071	375	0.111	521.1
C321	7	71.911	71.471	100	1.619	46
C322	7.001	70.672	69.852	150	0.916	14.9
C323	8	71.379	70.639	150	0.936	44.3
C324	8.001	71	69.703	150	0.767	42.4
C325	7.002	70.566	68.936	150	0.816	56.9
C19A	3.009	70.2	67.96	375	0.057	493.2
C15	9	72.9	71.295	225	0.393	120
C16	9.001	72.88	70.827	300	0.352	142
C16A	9.002	72.56	70.475	300	0.4	149.9
C17	9.003	72.16	70.075	300	2.092	37
C20	3.01	71.08	67.903	375	0.153	110
C21	3.011	71.42	67.75	375	0.206	100.9
C22	3.012	70.69	67.544	375	0.129	253.5
C23	1.016	68.95	67.34	450	0.135	468.9
C23A	1.017	68.455	67.205	450	0.087	567.4
C23B	1.018	68.318	67.118	450	0.088	570